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Indian Standard

IS 17436 : 2020

स्वचल वाहन — पूर्व चेतावनी त्रिकोणीय संकेतक — विशिष्टि

Automotive Vehicles — Advance-Warning Triangle — Specification

ICS 43.040.20

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Automotive Electrical Equipment and Instruments Sectional Committee TED 11

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards after the draft finalized by the Automotive Electrical Equipment and Instruments Sectional Committee had been approved by the Transport Engineering Division Council.

Advance warning triangles are used to indicate the presence of the halted vehicle. This type of signaling device will serve as an advance warning to all the vehicles which may approach the halted vehicle. In order to serve its purpose, it is proposed to place the triangle on the carriageway at some distance prior to the actual position of the halted vehicle, so that the oncoming driver can take evasive action on seeing the triangle even before he/she sees the vehicle. The distance at which it is to be placed can be deliberated upon. Also the advance warning triangle is to be used both during the day and night.

In the formulation of this standard considerable assistance has been taken from AIS 022 : 2001 ‘Automotive vehicles – Advance-warning triangles — Specification’.

Central Motor Vehicles Rules 1989 refers to many Automotive Industry Standards (AIS) formulated by Automotive Industry Standards Committee (AISC) till such time corresponding Bureau of Indian Standards (BIS) Specifications are notified. Under the same provision Automotive Industry Standards (AIS) referred in this Indian Standard will be replaced by Bureau of Indian Standards Specifications after corresponding Bureau of Indian Standards Specifications are formulated and notified.

The composition of the Committee responsible for formulation of this standard is given at Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*).’ The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUTOMOTIVE VEHICLES – ADVANCE-WARNING TRIANGLES — SPECIFICATION

1 SCOPE

This standard covers requirements of advance-warning triangles intended to be on board motor vehicles and to be placed on the carriageway (road) in order to signal, by day and at night, the presence of a halted vehicle.

1.1 The motor vehicles mentioned above include all four wheelers except agricultural tractors.

2 REFERENCES

The standards given below contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

IS No.	*Title*
IS 2500 (Part 1) : 2000	Sampling procedures for inspection by attributes: Part 1 Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection (*Third Revision*)
8339 : 1993	Automotive vehicles — Reflex reflectors — Specification
IS/ ISO 105 (Part B 02) : 2014	Textiles —Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test
AIS 090 (Rev 1) : 2019	Approval of retro-reflective markings for motor vehicles, their trailers and semi-trailers

3 DEFINITIONS

For the purpose of this standard the definitions given in AIS 090 and the following shall apply.

3.1 Advance-warning Triangle — The device intended to be on board motor vehicles and to be placed on the carriageway (road) in order to signal, by day and at night, the presence of a halted vehicle and in the form of an equilateral triangle.

3.2 Type of Triangle — Advance-warning triangles which do not differ in such essential respects as

a) Manufacturer
b) Optical characteristics
c) Distinctive geometrical and mechanical features of the design

3.3 Retro-reflecting Device — An assembly, ready for use, comprising one or more retro-reflecting optical units

3.4 Front Face of the Triangle — The face carrying the optical units

3.5 Axis of the Advance-warning Triangle — The straight line which, perpendicular to the front face of the triangle, passes through its centre.

3.6 Fluorescent Material — Material which either in the mass or at the surface, when excited by daylight, exhibits the phenomenon of photo-luminescence ceasing rather shortly after excitation.

3.7 Luminance Factor — The ratio of the luminance of the body considered to the luminance of the perfect diffuser under identical conditions of illumination and observation. The luminance of the body considered includes that produced by reflection and by fluorescence;

3.8 Co-efficient of Luminous Intensity (CIL) — The value obtained by dividing the luminous intensity reflected in the direction considered, by the illumination of the retro-reflecting device, for given observation, entrance and rotation angles.

4 TYPE

4.1 The advance warning triangle shall be of following types

a) Foldable type, and
b) Non-foldable type.

4.2 The manufacturer shall declare, if protection to warning triangle is through protective cover or through other means.

5 GENERAL SPECIFICATIONS

5.1 The advance-warning triangle shall be open at the centre and shall comprise a red border composed of an outer retro-reflecting strip and an inner fluorescent strip, the whole supported at a certain height above the surface of the carriageway. The open centre and the fluorescent and retro-reflecting strips shall be bounded by concentric equilateral triangle contours.

5.2 Advance-warning triangles shall be so made that in normal use (on the road and when carried in the vehicle) they retain the prescribed characteristics and their satisfactory functioning continues to be ensured.

5.3 The optical units of the advance-warning triangle shall not be easily disassembled. The various parts making up the advance-warning triangle shall provide good stability on the road. They shall not be easily disassembled. If a triangle has to be folded in order to be placed in its protective cover, the movable parts, including its supports, shall not be detachable.

5.4 When the advance-warning triangle is in the position of use on the road, the front face of the triangle must be vertical. This condition is deemed fulfilled if the axis of the triangle does not form an angle of more than 5° with the base plane.

5.5 The front face of the advance-warning triangle shall be easy to clean; in particular it shall not be rough, and such protuberances as it may exhibit shall not prevent such cleaning.

5.6 The advance-warning triangle and its support shall not present sharp edges or corners.

5.7 The advance-warning triangle shall be accompanied by its protective cover, if any, for protection against external agents, especially during carriage. It may however be supplied without protective cover where the necessary protection is provided by other means. These means shall be stated as mentioned in **4.2**.

5.8 Each triangle may be accompanied by a copy of the instructions.

6 PARTICULAR SPECIFICATIONS

6.1 Requirements of Shape and Dimensions

6.1.1 Shape and dimensions of the warning triangle shall be as given in Annex A.

6.1.1.1 The theoretical sides of the triangle shall be at least 500 ± 50 mm in length.

6.1.1.2 The retro-reflecting units shall be arranged along the edge within a strip of an unvarying width which shall be between 25 mm and 50 mm.

6.1.1.3 Between the outer edge of the triangle and the retro-reflecting strip, there may be an edging not more than 5 mm wide and not necessarily red-coloured.

6.1.1.4 The retro reflecting strip may be continuous or not. In the latter case the free area of the supporting material must be red.

6.1.1.5 The fluorescent material must be contiguous to the retro-reflecting units. It shall be arranged symmetrically along the three sides of the triangle. When in use, its surface area shall be not less than 315 cm^2. However, an edging, continuous or not, not more than 5 mm wide, which need not necessarily be red-coloured, may be placed between the retro-reflecting surface and the fluorescent surface.

6.1.1.6 The side of the open central triangle shall have a minimum length of 70 mm.

6.1.2 *Shape and Dimensions of the Support*

The distance between the supporting surface and the lower side of the advance-warning triangle shall not exceed 300 mm.

6.2 Colorimetric Specifications

6.2.1 *Retro-reflecting Devices*

6.2.1.1 Retro-reflecting devices shall be made of material coloured red in the mass.

6.2.1.2 When the retro-reflecting device is illuminated by the CIE standard illuminant A, with an observation angle of 0°20′ and an entrance angle $V = H = 0°$, or, if this produces a colourless surface reflection, an angle $V = \pm 5°$, $H = 0°$, the trichromatic co-ordinates of the red reflected luminous flux shall be within the following limits:

a) Limit towards yellow: $y \leq 0.335$
b) Limit towards purple: $z \leq 0.008$

6.2.1.3 The testing of the colour shall be carried out as per **C-2.1**.

6.2.2 *Fluorescent Materials*

6.2.2.1 The fluorescent materials shall either be coloured in the mass or take the form of separate coatings applied to the surface of the triangle.

6.2.2.2 When the fluorescent material is illuminated by the CIE standard illuminant C the trichromatic co-ordinates of the light reflected and emitted by the fluorescence shall be within an area of which the corner points are determined by the following co-ordinates [the angle of illumination being 45° and the observation being made at an angle of 90° to the sample (45°/0° measuring geometry)]:

Point	1	2	3	4
x	0.690	0.595	0.569	0.655
y	0.310	0.315	0.341	0.345

6.2.2.3 The testing of colour shall be carried out as per **C-2.2**.

6.3 Photometric Specifications

6.3.1 *Retro-reflecting Devices*

6.3.1.1 The values of CIL of retro-reflecting optical units shall be not less than those given in Table 1, for the angles of observation (or divergence) and the entrance (illumination) angle shown

6.3.1.2 The CIL measured on random slices of 50 mm length of the retro-reflecting device shall lie between extremes having a ratio not in excess of 3. These slices are taken between the perpendiculars to the side of the triangle and passing through the corresponding apexes of the central aperture. This requirement applies to an angle of divergence (α) of 20′ and to illumination angles of $V = 0°$, $H = 0°$ or ± 5° and $V = \pm 20°$, $H = 0°$.

6.3.1.3 Diversity of luminance at angles of illumination (β) of $V = 0°$, $H = \pm 30°$ and $V = 0°$, $H = \pm 40°$ shall be tolerated on condition that the triangular shape remains clearly discernible, for an angle of divergence of 20′ and an illumination of approximately 1 lux.

6.3.1.4 The measurements referred to in Table 1 shall be measured as per **C-4**.

6.3.2 *Fluorescent Materials*

6.3.2.1 The luminance factor including the luminance by reflection and fluorescence, shall not be less than 30 percent.

6.3.2.2 The measurement of luminance factor shall be taken as per **C-3**.

7 TEST PROCEDURE

7.1 Every advance-warning triangle and its protective cover, if any, shall meet the requirements given in Annex C.

7.2 Four samples of advance-warning triangle and at least two protective covers, if advance-warning triangles are to be supplied with protective covers, shall be selected for testing.

7.3 Two samples of the fluorescent material in which a square of 100 mm can be inscribed and which are fully representative of the material applied under the same conditions to the same base material as used for the advance-warning triangle.

8 MARKINGS

8.1 Every advance-warning triangle and its protective cover shall bear the trade name or mark of the manufacturer. Such marking shall be clearly legible, indelible and shall be visible from the outside.

8.2 BIS Certification Marking

The advance-warning triangle may also be marked with the Standard Mark.

8.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

9 SAMPLING

Unless otherwise agreed upon between a supplier and purchaser, the inspection sampling shall be as per IS 2500 (Part 1).

Table 1 Values of Co-efficient of Luminous Intensity (CIL) in Milli-candela per Lux

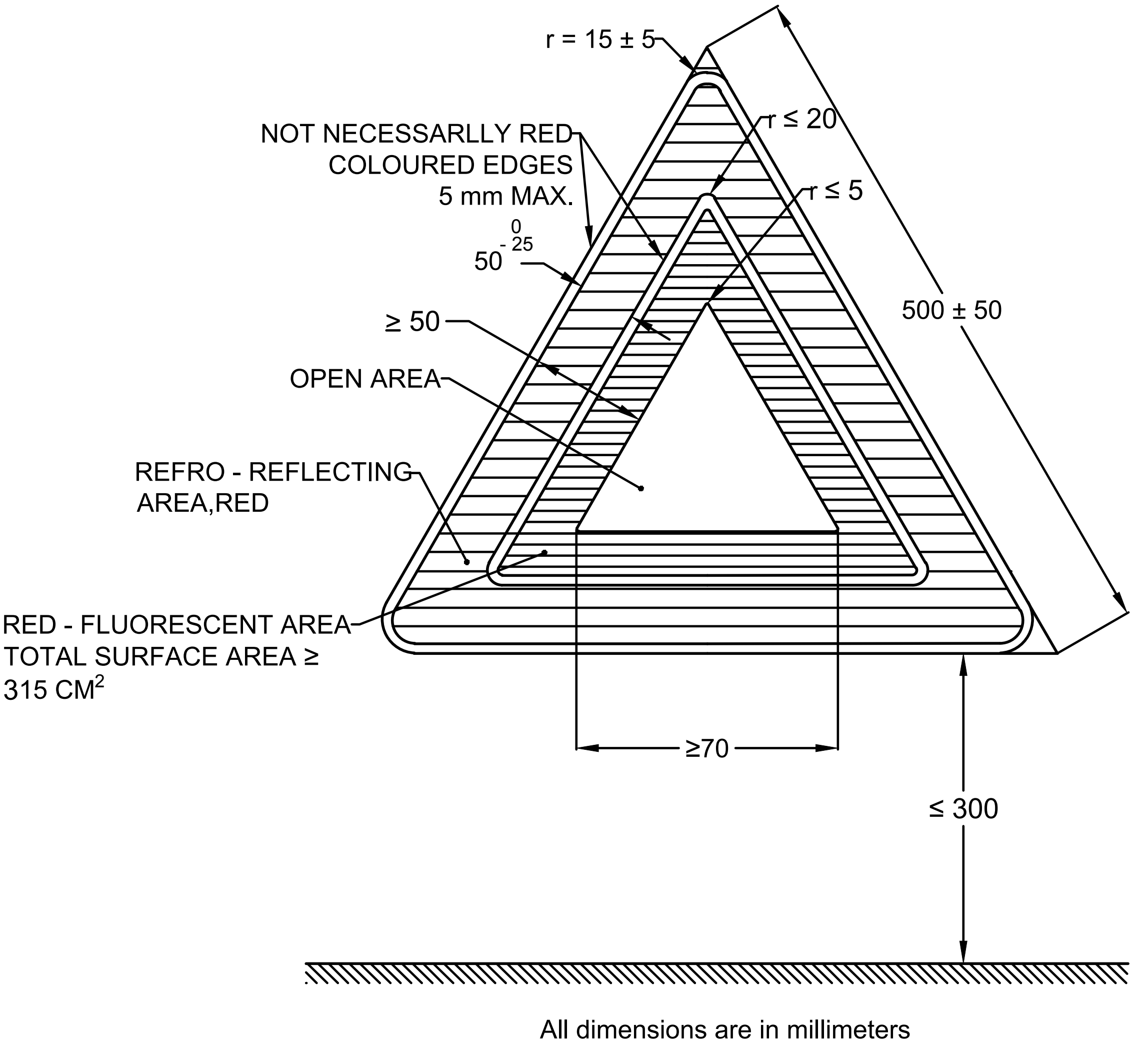
(*Clause* 6.3.1.1)

Angles of Divergence (α)		**Illumination Angle** (β)			
	Vertical V (β_1)	0	± 20°	0°	0°
	Horizontal H (β_2)	0 or ± 5°	0°	± 30°	± 40°
20′		8 000	4 000	1 750	600
1° 30′		600	200	100	50

ANNEX A

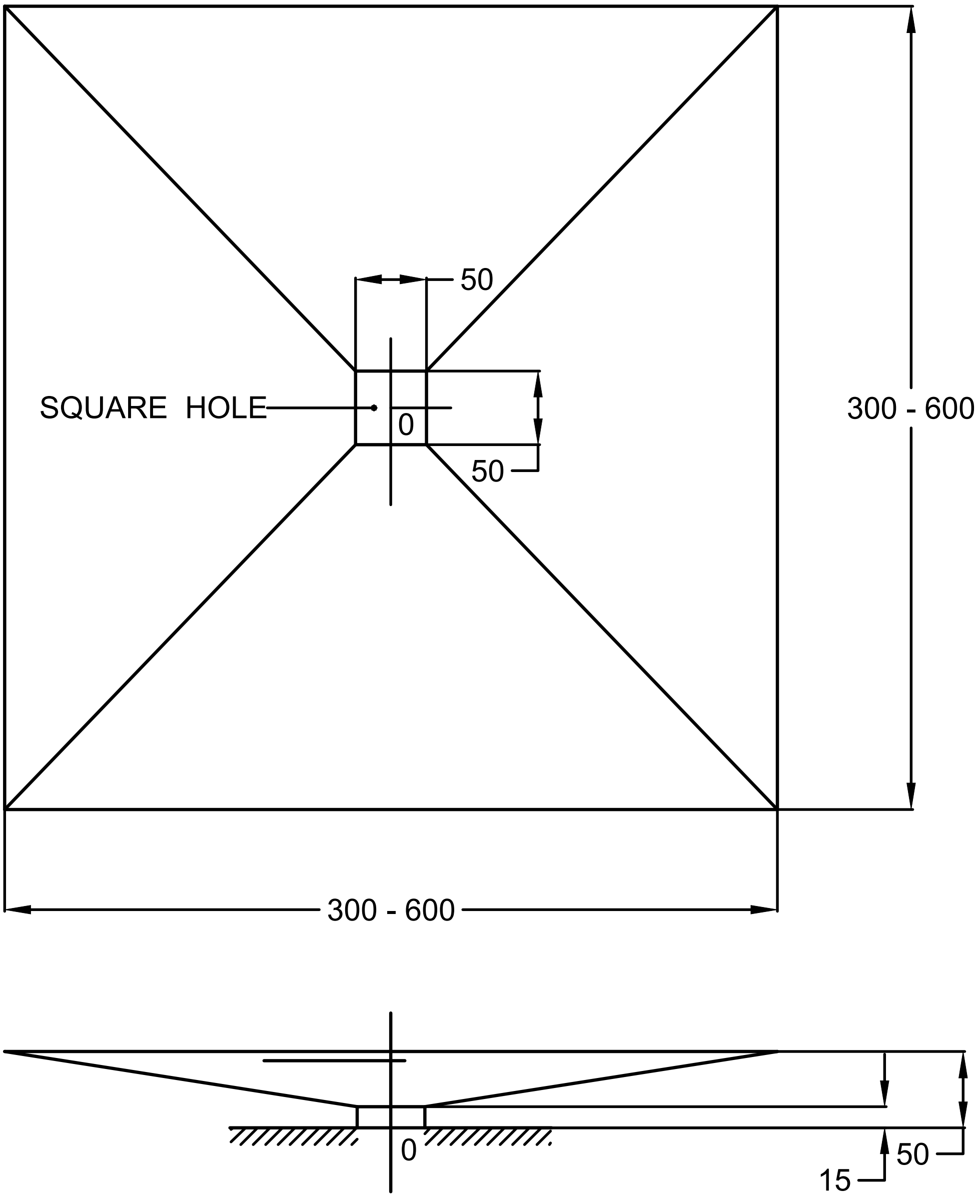
(*Clause* 6.1.1)

SHAPE AND DIMENSIONS OF ADVANCE-WARNING TRIANGLE


r = 15 ± 5
NOT NECESSARLLY RED COLOURED EDGES 5 mm MAX.
r ≤ 20
r ≤ 5
50 0 - 25
≥ 50
500 ± 50
OPEN AREA
REFRO - REFLECTING AREA,RED
RED - FLUORESCENT AREA TOTAL SURFACE AREA ≥ 315 CM2
≥70
≤ 300
All dimensions are in millimeters

All dimensions in millimetres.

FIG. 1 SHAPE AND DIMENSIONS OF ADVANCE-WARNING TRIANGLE AND OF SUPPORT



All dimensions in millimetres.

Fig. 2 Test Device for Clearance to Ground

ANNEX B

(*Clause* C-11.1)

DETERMINATION OF THE ROUGHNESS OF THE ROAD SURFACE - SANDY BEACH METHOD

B-1 PURPOSE OF THE METHOD

The purpose of this method is to describe and to determine to a certain extent the geometric roughness of that part of the road surface on which the advance-warning triangle is placed during the test of stability in wind, as required in **C-11.1**.

B-2 PRINCIPLE OF THE METHOD

B-2.1 A known volume V of sand is spread evenly on the surface of the carriageway (road) in the form of a circle. The 'mean sand depth' is calculated from following formula

$$H_s = \frac{V}{S}$$

where

H_s = mean sand depth, in mm;

V = volume of sand, in ml; and

S = area covered, in mm^2.

B-2.2 The test is carried out by means of round-grain, dry sand and having a grain size between 0.160 mm and 0.315 mm. The volume (V) amounts to 25 ml ± 0.15 ml. The sand is spread out over the surface where the test is carried out by means of a flat, circular disc with a diameter of 65 mm, one side of which is covered with a sheet of rubber having a thickness of 1.5 - 2.5 mm and the other being provided with an appropriate handle. If the diameter of the circular area covered with sand is D, the mean sand depth will be calculated from the formula:

$$H_s = (4/\pi) \times (25/D^2) \times 10^3$$

where

H_s = mean sand depth, in mm; and

D = dia of the covered area, in mm;

B-3 PERFORMANCE OF THE TEST

B-3.1 The surface on which the test is to be carried out must be dry and at first be brushed with a soft brush to remove any dirt or loose gravel.

B-3.2 The sand which has been firmly filled into an appropriate receptacle is then poured out on the surface to be tested in a single heap. The sand is then carefully spread out on the surface by means of repeated circular movements of the rubber faced disc so as to form the largest possible round area covered with sand. The sand will then fill all depressions and hollows.

B-3.3 Two diameters, at right angles to one another, of the 'beach' thus formed are usually measured. The mean value is rounded off to the nearest 5 mm, with the depth of the sand (H_s) being calculated according to the formula given in **B-2.2**.

B-3.4 Six tests of this kind are carried out on the supporting surface, with the parts to be tested being distributed over the surface to be tested as evenly as possible. The overall mean of the results obtained is given as the mean sand depth (H_s) of the road surface where the advance-warning triangle has been placed.

ANNEX C

(*Clause* 6.2.1.3, 6.2.2.3, 6.3.1.4, 6.3.2.2 *and* 7)

TEST PROCEDURES

C-1 GENERAL

C-1.1 After verification of the general specifications as per **5** and the specifications of shape and dimensions as per **6.1.1**, all samples shall be subjected to the heat resistance test as per **C-7**.

C-1.2 After the heat resistance test and subsequent storage for 12 consecutive hours at a temperature of 25 ± 5° C, the advance warning triangle, in its protective cover, shall be subjected to the cold test according to **C-8.** Immediately after removal from the cold room, no fractures or visible distortion shall be noticeable on the device and especially on its optical parts. The protective cover, if provided, shall be properly openable, and shall neither tear nor adhere to the advance – warning triangle.

C-1.3 The CIL value of the four samples of the advance-warning triangles submitted, shall be measured at an observation angle of 20' and at an illumination angle with the components $V = 0°$, $H = \pm 5°$. The test shall be carried out as per at **C-4**.

C-1.4 The two triangles which show the smallest and the largest CIL value during the tests carried out as per **C-1.3** shall be visually compared, during daylight and at a distance of 30 m by an observer having normal colour response, with the other two samples (*see* **7.2**). There shall be no noticeable difference in colour or luminance between the fluorescent material on the four samples.

C-1.5 The two samples with the smallest and the largest CIL value shall be subsequently subjected to the following tests:

a) Measurement of the values of the CIL in respect of the observation and illumination angles referred to in **6.3.1.1** and **6.3.1.2** as per **C-4**. The visual inspection as per **6.3.1.3** and **6.3.1.4** shall then be performed;
b) Testing of the colour of the retro-reflected light as per **C-2** on the sample which, as a result of a visual inspection seems to have the least favourable colorimetric characteristics. In other cases the sample with the highest CIL concerned shall be examined;
c) Test of clearance to ground as per **C-5**; and
d) Mechanical solidity test as per **C-6**.

C-1.6 One sample other than those referred to in **C-1.4** above shall be subjected to test of resistance to penetration of water into the retro-reflecting device as per **C-12.1** or if relevant, test of resistance of the accessible reverse side of the mirror-backed retro-reflecting device, as per **C-12.2**.

C-1.7 The second sample, other than those referred to in **C-1.4** above shall be subjected to the following tests:

a) Water test as per **C-9**;
b) Test of resistance to fuels as per **C-10**; and
c) Test of stability against wind as per **C-11**.

C-1.8 After the tests specified in the **C-1.4**, the two samples of the fluorescent material (*see* **7.3)** shall be subjected to the following tests:

a) Colour test as per **C-2.2**;
b) Determination of luminance factor of the fluorescent material as per **C-3**; and
c) Test of weather resistance as per **C-13**.

C-2 COLOUR TESTS

C-2.1 Colour of the Retro-reflecting Devices

C-2.1.1 The colour of the retro-reflecting devices to be tested as per **6.2.1** may be ascertained visually by observers having normal colour response, by means of comparison with coloured lights, the trichromatic co-ordinates of which is adequately within the colour limits defined in **6.2.1.2.**

C-2.1.2 If any doubt remains after this test, compliance with the colorimetric specifications shall be verified by determining the trichromatic co-ordinates of the most doubtful sample.

C-2.2 Colour of the Fluorescent Material

C-2.2.1 The colour of the fluorescent material to be tested as per **6.2.2** may be ascertained visually by the observers having normal colour-response, by comparison with fluorescent materials, the trichromatic co-ordinates of which is adequately within the colour limits defined in **6.2.2.2**. The illumination and observation of the samples shall be carried out in the measuring geometry 45°/0°, and the illuminance shall be chosen so as to ensure photopic vision.

C-2.2.2 If any doubt remains after this test, compliance with the colorimetric specifications shall be verified by determining the trichromatic co-ordinates of the most doubtful sample.

C-3 DETERMINATION OF THE LUMINANCE FACTOR OF THE FLUORESCENT MATERIAL

C-3.1 For the determination of the luminance factor the sample shall be illuminated by a light source of the CIE illuminant C, at an angle of illumination of 45° to the normal, and the light emitted by luminosity and reflection observed in the direction of the normal (geometry 45°/0°) shall be measured. The luminance factor may be obtained by the following method:

C-3.1.1 By putting the luminance of the sample into relation to the luminance of a perfect diffuser whose luminance factor is known under identical conditions of illumination and observation; the luminance factor of the sample shall be calculated from the formula:

$$\beta = \frac{L}{L_o} \times \beta_o$$

where

β = luminance factor of the sample;
L = luminance of the sample;
L_o = luminance of a perfect diffuser; and
β_o = luminance factor of a perfect diffuser.

C-3.1.2 When the colour of the fluorescent material has been colorimetrically determined as per **C-2.2.2**, the luminance factor of the sample shall be calculated from the formula

$$\beta = Y/\ Y_o$$

where

β = luminance factor of the sample,
Y = tristimulus value of the sample, and
Y_o = tristimulus value of the perfect diffuser.

C-4 MEASUREMENT OF THE CIL VALUE OF RETRO-REFLECTING DEVICES

C-4.1 For this measurement it is assumed that the direction of illumination $H = V = 0^\circ$ for the advance-warning triangle in its position of use is parallel to the base plane and vertical to the lower side of the triangle, which in turn is parallel to the said plane.

C-4.2 The CIL value shall be measured as per method described in Annex D.

C-5 TEST OF CLEARANCE TO GROUND

C-5.1 The advance-warning triangle shall pass the following tests:

C-5.1.1 The apparatus as shown in Annex A, Fig. 2, (inverted hollow pyramid) shall be placed on a horizontal base plane.

C-5.1.2 The individual supports to the ground shall be placed one after another in the square hole O of the test apparatus. During the test of each support, it shall be required to find a position of the test apparatus in relation to the advance-warning triangle and its supporting device, which is favourable for the triangle and which ensures that:

C-5.1.2.1 All supports are resting simultaneously on the base plane,

C-5.1.2.2 Outside the area covered by the test apparatus, the distance between the base plane and parts of the triangle as well as of the supporting device is 50 mm, *Min* (with the exception of the supports proper).

C-6 MECHANICAL SOLIDITY TEST

C-6.1 With the advance-warning triangle set up as specified by the manufacturer and its bases firmly held, a force of 2 N shall be applied to the apex of the triangle parallel to the supporting surface and normal to the lower side of the triangle.

C-6.2 The apex of the triangle shall not move more than 5 cm in the direction in which the force is exerted.

C-6.3 After the test, the position of the device shall not be significantly different from its original position.

C-7 HEAT RESISTANCE TEST

C-7.1 The advance-warning triangle in its protective cover, if provided, shall be kept for 12 h at a temperature of 70 ± 3° C.

C-7.2 After the test, no cracking or noticeable distortion of the device, in particular of the retro-reflecting device shall be visible. The cover shall be openable and shall not adhere to the triangle.

C-8 COLD TEST

The advance-warning triangle in its protective cover shall be tested for low temperature use at a temperature of -10° C for 12 h.

C-9 WATER TEST

The collapsible advance-warning triangles shall be assembled for use and immersed flat for 2 h in water at a temperature of 25 ± 5° C, with the active face of the triangle slowing upwards and below 5 cm from the surface of the water. After 2 h the triangle shall be removed and dried. No part of the device may exhibit clear signs of deterioration which might impair the effectiveness of the triangle.

C-10 TEST OF RESISTANCE TO FUELS

C-10.1 The triangle and its protective cover shall be immersed separately in a tank containing a mixture of petrol and benzene (proportion 90:10). After 60 s they shall be removed from the tank and drained of excess liquid. The triangle shall then be placed in its protective cover and the unit shall be laid flat in a still atmosphere. When completely dried, the triangle shall not adhere to its protective cover, and there shall be no visually noticeable change on its surface and no apparent detrimental modifications, however, slight surface cracks may be tolerated.

C-11 TEST OF STABILITY AGAINST WIND

C-11.1 The advance-warning triangle shall be set up in a wind tunnel, on a base measuring about 1.5 m × 1.2 m formed of a road surface as normally used. This surface shall have a geometric roughness $H_s = 0.5 \pm 0.05$ mm (*see* Annex B).

C-11.1.1 When set up in this manner, the advance-warning triangle shall be subjected for 3 min to an air stream exerting a dynamic pressure of 180 Pa (about 60 km/h under normal conditions) parallel to the supporting surface, in a direction which seems to be most unfavourable for the stability.

C-11.2 Alternative Test Method

The advance-warning triangle shall be set up on asphalted road and subjected for 3 min to an air stream exerting a dynamic pressure of 180 Pa (about 60 km/h under normal conditions) parallel to the supporting surface, in a direction which seems to be most unfavorable for the stability.

C-11.3 When tested as per **C-11.1** or **C-11.2** the advance-warning triangle shall neither overturn nor shift. Slight shifting of the points of contact with the road surface, by not more than 5 cm, is allowed.

C-11.4 The triangular part of the device shall not rotate through more than 10° round a horizontal axis or a vertical axis from its initial position.

C-12 TEST OF RESISTANCE OF THE RETRO-REFLECTING DEVICE

C-12.1 Test of Resistance to penetration of water

C-12.1.1 The collapsible advance-warning triangle shall be assembled for use and immersed for 10 min in water at a temperature of 50 ± 5° C, with the highest point of the upper part of the illuminating surface, 20 mm below the water surface. Immediately afterwards the retro-reflecting device shall be immersed in the same way in water at a temperature of 25 ± 5° C.

C-12.1.2 After this test, no water shall have penetrated to the reflecting surface of the retro-reflecting device. A device clearly revealing the presence of water in a visual inspection shall be considered not complying with the standard.

C-12.1.3 If the visual inspection does not reveal the presence of water, or in case of doubt the CIL values shall again be measured under the same conditions as specified in **C-1.3** after the retro-reflecting device has been gently shaken to remove excess water from the outside. The CIL values shall not diminish by more than 40 percent of the values recorded before the test.

C-12.2 Test of Resistance of the Accessible reverse side of the mirror-backed retro-reflecting device

C-12.2.1 The reverse side of the retro-reflecting device shall be brushed with a hard nylon brush and then thoroughly wetted with a mixture of petrol and benzene (proportion 90:10). After 1 min, the mixture shall be removed and the device allowed to dry. As soon as evaporation is completed, the reverse side shall be brushed with the same brush as before. The whole surface of the mirror-coated reverse side shall be covered with Indian ink and CIL values shall be measured under the same conditions as specified in **C-1.3.** The CIL shall not diminish by more than 40 percent of the values recorded before the test.

C-13 TEST OF WEATHER-RESISTANCE OF THE LUMINANCE FACTOR AND OF THE COLOUR OF THE FLUORESCENT MATERIAL

C-13.1 One of the samples of the fluorescent material (*see* **7.3**) shall be subjected to a temperature and irradiation test as per ISO 105 until the contrast No. 4 of the grey scale has been reached for the reference sample no. 5.

C-13.2 After this test, the colour co-ordinates of the fluorescent material shall comply with colour specification of **6.2.2.2**. The luminance factor (*see* **C-3**) shall be at least 30 percent and shall not increase by more than 5 percent compared with the value recorded before the test (*see* **C-1.8.2**).

C-13.3 The sample shall not exhibit any visible damage such as cracks, scaling or peeling of the fluorescent material.

ANNEX D

(*Clause* C-4.2)

METHOD OF MEASUREMENT OF THE CIL VALUE OF THE RETRO-REFLECTING DEVICE

D-1 DEFINITIONS

The notations used in Fig. 3 to Fig. 6 are defined in **3** and AIS 090.

D-2 DIMENSIONAL AND PHYSICAL SPECIFICATIONS FOR THE PHOTOMETRY OF RETRO-REFLECTORS

D-2.1 The CIE-angular system shown in Fig. 3 shall be used. An adequate support (goniometer) is demonstrated in Fig. 4.

D-2.2 Measuring Distance

The measuring distance shall be 10 m *Min* or its optical equivalent and shall be so chosen that at least the limits for the angles δ, γ and η as given in Fig. 6 are respected.

D-2.3 Illuminance at the Retro-Reflector

The illuminance over the useful area of the retro-reflector, measured perpendicular to the incident light shall be sufficiently uniform. A check on this condition requires a measuring element, the sensitive area of which is not greater than one-tenth of the area to be examined. The variation in the value of the illuminance shall then comply with the condition:

$$\frac{\text{Maximum value}}{\text{Minimum value}} \leq 1.05$$

D-2.4 Colour Temperature and the Spectral Distribution of the Source

The source used for illuminating the retro-reflector shall as far as possible represent the CIE illuminant A, both as regards colour temperature and spectral power distribution.

D-2.5 Photometer Head (Measuring Element)

D-2.5.1 The photometer head shall be corrected to the spectral luminous efficiency for the CIE standard photometric observer in photopic vision.

D-2.5.2 The device shall not show a perceptible change in local sensitivity within the area

of its aperture; otherwise suitable provisions must be added, for example the application of a diffusing window at a certain distance in front of the sensitive surface.

D-2.5.3 Experience has shown that non-linearity of photometer heads may be a problem with the very small quantities which are the rule in the photometry of retro-reflectors. A check at comparable illuminance levels on the photometer head is recommended.

D-2.6 The Influence of a Regular Reflection

The amount and distribution of the regular reflection from the surface of the retro-reflector depends on the flatness and the gloss of the surface. In general, the regular is best avoided when the reference axis is placed so that the regular reflection is directed on the opposite side of the source from the photometer head (for example with $\beta_1 = -5°$)

D-2.6.1 The CIE angular system for specifying and measuring retro-reflectors. The first axis is perpendicular to the plane containing the observation axis and the illumination axis. The second axis is perpendicular both to the first axis and to the reference axis. All axes, angles, and directions of rotation are shown positive.

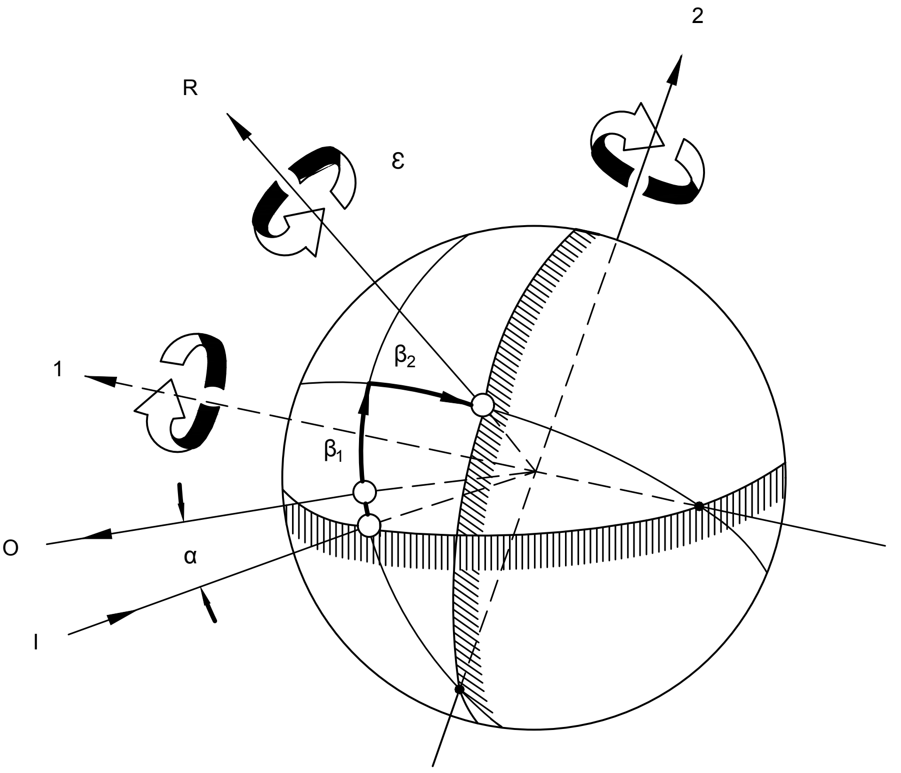
NOTES

1 The principal fixed axis is the illumination axis.

2 The first axis is fixed perpendicular to the plane containing the observation and illumination axis.

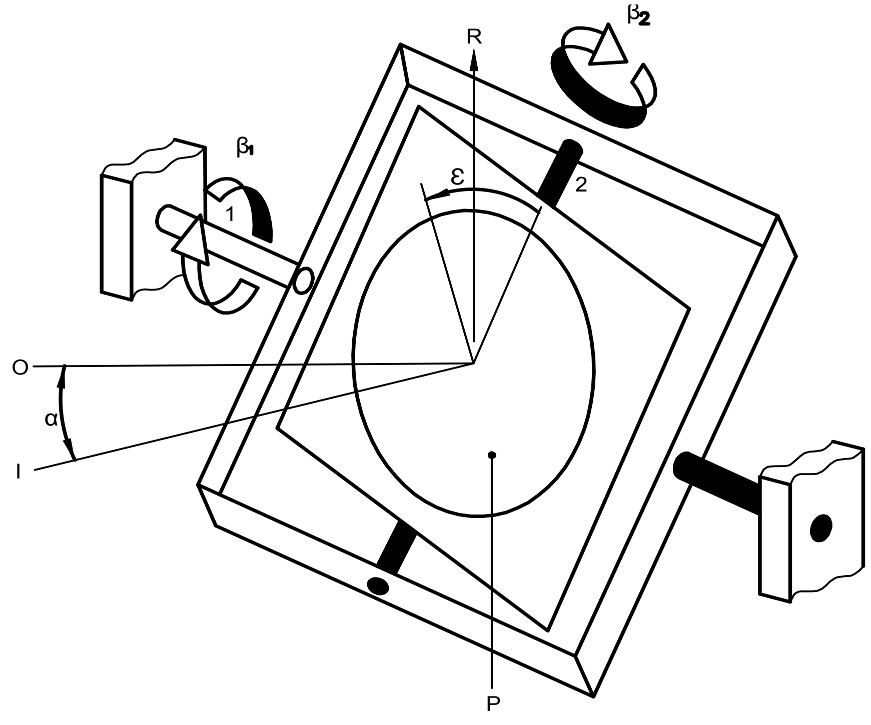
3 The reference axis is fixed in the retro-reflector and moveable with β_1 and β_2.

D-2.6.2 Representation of a goniometer mechanism embodying the CIE angular system for specifying and measuring retro-reflectors. All angles and directions of rotation are shown positive.



1	:	First Axis	*I*	:	Illumination Axis	α	:	Observation angle
2	:	Second Axis	*O*	:	Observation Axis	β_1, β_2	:	Entrance angles
R	:	Reference Axis				ε	:	Rotation angle

FIG. 3 CIE CO-ORDINATE SYSTEM



1	:	First Axis	*I*	:	Illumination Axis	α	:	Observation angle
2	:	Second Axis	*O*	:	Observation Axis	β_1, β_2	:	Entrance angles
			R	:	Reference Axis	ε	:	Rotation angle
			P	:	Retro-reflective material			

Fig. 4 Goniometer Mechanism Embodying the CIE Angular System

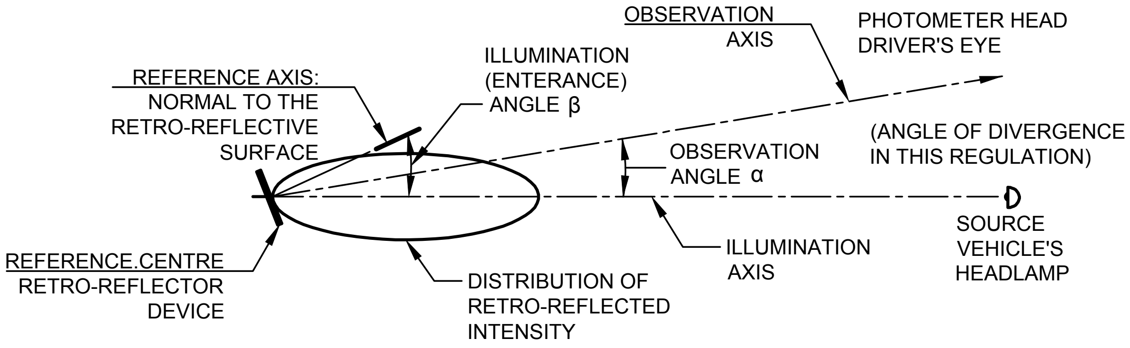

OBSERVATION AXIS
PHOTOMETER HEAD DRIVER'S EYE
ILLUMINATION (ENTERANCE) ANGLE β
REFERENCE AXIS: NORMAL TO THE RETRO-REFLECTIVE SURFACE
(ANGLE OF DIVERGENCE IN THIS REGULATION)
OBSERVATION ANGLE α
REFERENCE.CENTRE RETRO-REFLECTOR DEVICE
ILLUMINATION AXIS
SOURCE VEHICLE'S HEADLAMP
DISTRIBUTION OF RETRO-REFLECTED INTENSITY

Fig. 5

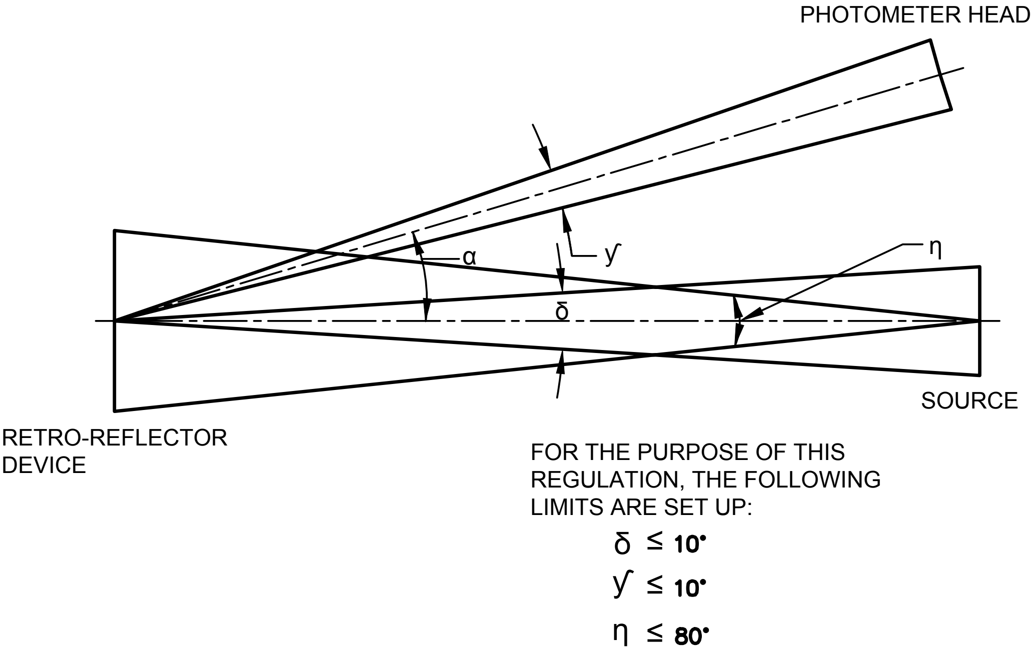

PHOTOMETER HEAD
α
γ
η
δ
SOURCE
RETRO-REFLECTOR DEVICE
FOR THE PURPOSE OF THIS REGULATION, THE FOLLOWING LIMITS ARE SET UP:
δ ≤ 10°
γ ≤ 10°
η ≤ 80°

FIG. 6 LIMITS FOR THE ANGLES

ANNEX E

(*Foreword*)

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